Section III. REMARKS

The pending claims in the application are 1, 3-5, 7-21 and 23-51.

Amendment of Claims 1, 3, 9, 10, 12, 15, 20, 21, 23, 25, 26, 31, 35 and 49

Claims 1, 3, 9, 10, 12, 15, 20, 21, 23, 25, 26, 31, 35 and 49 have been amended herein to advance the application to allowance.

Claim 1 has been amended to recite:

> **"1. A plasma-assisted dry etching method for etching a noble metal material, said method comprising:**
>
> **contacting the noble metal material with an energized plasma composition comprising an etching species mixture for sufficient time to at least partially etch said noble metal material, wherein the etching species mixture comprises (i) at least one halogenated compound selected from the group consisting of organic halogenated compounds, inorganic halogenated compounds and mixtures thereof, and (ii) an oxidizing agent selected from the group consisting of oxygen and ozone, wherein the energized plasma composition contacting the noble metal material lacks nitrogen- and phosphorous-containing species, and wherein the noble metal material comprises Ir."**

Support for such amendment can be found in the instant specification on page 5, paragraph [0013] and page 6, paragraphs [0017] and [0019].

Corresponding amendment has been made in method claims 21, 35 and 49.

Typographical errors have been corrected in claims 3 and 23, wherein "C_2H_6" has been amended to read "C_2F_6." Support for such amendment can be found in the instant specification on page 11, paragraph [0034].

Additionally, a typographical error in the form of improper punctuation has been corrected in claim 15.

Claims 3, 12 and 20 have been amended to depend from claim 1, and claims 25 and 31 have been amended to depend from claim 21.

In response to the objections to claim 9 as reciting "wherein the co-reactant is selected from the group consisting of elemental silicon and quartz," claim 9 has been amended as proposed by the Examiner (at page 2, lines 5-6 of the December 3, 2003 Office Action) to recite "wherein the co-reactant precursor is selected from the group consisting of elemental silicon and quartz." Claim 26 has been likewise amended to comply with the Examiner's suggestion.

In response to the Examiner's objection to claim 10 as reciting "XF_2," claim 10 has been amended to recite "XeF_2" as specified by the Examiner.

In response to the Examiner's objection to claim 21 as erroneously reciting "continuing step (c) . . . ," claim 21 has been amended to recite steps (a) – (d), thereby overcoming such objection.

By the above-discussed amendments, all claims are now in proper form for allowance.

Double Patenting Rejection Under the Judicially Created Doctrine of Obviousness-Type Double Patenting

1. In the December 3, 2003 Office Action, claims 1-51 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims of Baum et al. (U.S. Patent No. 6,143,191).

In response to the rejection, a terminal disclaimer is enclosed and submitted herewith under the provisions of 37 C.F.R. §1.321(c), to overcome such obviousness-type double patenting rejection.

2. In the December 3, 2003 Office Action, claims 1-51 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims of Van Buskirk et al. (U.S. Patent No. 6,254,792) (hereinafter Van Buskirk). Applicants traverse such rejection.

As a matter of law, the test for obviousness-type double patenting is whether the claimed invention of the subject application would have been obvious from the subject matter of the claims in the cited reference, in light of the prior art. *See, In re Longi*, 225 U.S.P.Q. 645 (Fed. Cir. 1985). Further, the initial burden of establishing a *prima facie* case of obviousness is always on the Examiner. *In re Oetiker*, 24 U.S.P.Q.2d 1443 (Fed. Cir. 1992).

In the present case, the Examiner has failed to provide any basis to support the conclusion that applicants' claimed invention is an obvious variation of the Van Buskirk claims.

Van Buskirk broadly claims a method for removing from a microelectronic device structure a noble metal residue comprising iridium, the method comprising contacting the structure with a gas-phase reactive halide composition comprising XeF_2. Dependent claims thereunder further comprise the inclusion of an agent, including carbon monoxide, trifluorophosphine and trialkylphosphines, in the gas-phase reactive composition.

Applicants' claimed invention is patentably distinct over the claims of Van Buskirk. For example, applicants' base claim 1 recites, *inter alia*:

> **"contacting the noble metal material with an energized plasma composition comprising an etching species mixture for sufficient time to at least partially etch said noble metal material, wherein the etching species mixture comprises (i) at least one halogenated compound selected from the group consisting of organic halogenated compounds, inorganic halogenated compounds and mixtures thereof, and (ii) an oxidizing agent selected from the group consisting of oxygen and ozone . . . ."** (emphasis added)

The claims of Van Buskirk do not teach or suggest every limitation of applicants' claim 1, including the inclusion of an oxidizing agent in the etching species mixture.

Moreover, the claims of Van Buskirk do not motivate or suggest the use of oxidizing agents in the etching gas mixture, as required by applicants' claim 1. The agents claimed in Van Buskirk, including carbon monoxide, trifluorophosphine and trialkylphosphine, are NOT considered oxidizing agents. In fact, carbon monoxide is a well known and established reducing agent, and PF_3 forms complexes with transition metals similar to those formed by CO.[1]

Additionally, the claims of Van Buskirk provide no reasonable expectation of success. One skilled in the art referring to Van Buskirk would not reasonably expect that the inclusion of **oxidizing agents** in the etching gas mixture, instead of (reducing agent) CO, PF_3 or PR_3, would assist in volatilizing and removing noble metal residue on the microelectronic device structure.

[1] See, F.A. Cotton, G. Wilkinson, *Advanced Organic Chemistry*, John Wiley & Sons, New York, 5th ed., 1988, pg 392.

Because the claims of Van Buskirk do not teach, suggest or motivate all the limitations of applicants' claimed invention and because there is no reasonable expectation of success, applicants respectfully request withdrawal of the judicially created doctrine of obviousness-type double patenting rejection of claims 1-51 over claims of Van Buskirk.

3. In the December 3, 2003 Office Action, claims 1-51 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims in allowed, co-pending U.S. Patent Application No. 09/768,494. The Examiner has characterized the obviousness-type double patenting rejection as provisional "because the conflicting claims, while having been allowed, are not yet patented."

In response to the rejection, a terminal disclaimer is enclosed and submitted herewith under the provisions of 37 C.F.R. §1.321(c), to overcome such obviousness-type double patenting rejection.

Allowable Subject Matter

The Examiner's allowance of claims 42-48, subject to overcoming the judicially created doctrine of obviousness-type double patenting rejection, is acknowledged.

In the December 3, 2003 Office Action, the Examiner also indicated that claims 3, 8-10, 17, 18, 26, 29 and 32-34 would be allowable, subject to overcoming the judicially created doctrine of obviousness-type double patenting rejection, if rewritten in independent form including all of the limitations of the base claims and any intervening claims. Applicants acknowledge same, and submit that in light of the remarks set forth hereafter, all pending claims, including such claims 3, 8-10, 17, 18, 26, 29 and 32-34, as well as the claims from which claims 3, 8-10, 17, 18, 26, 29 and 32-34 depend, are fully in form and condition for allowance.

Rejection of Claims and Traversal Thereof

In the December 3, 2003 Office Action:

claims 1, 2, 4-6, 11-14, 21, 22, 25, 27, 30, 31, 35-38 and 51 were rejected under 35 U.S.C. §102(b) as being anticipated by Kosakowski et al. (U.S. Patent No. 5,575,888);

claims 1, 4, 5, 21 and 35-37 were rejected under 35 U.S.C. §102(b) as being anticipated by Matsumoto et al. (U.S. Patent No. 5,492,855);

claims 1, 11, 14, 21, 27 and 30 were rejected under 35 U.S.C. §102(b) as being anticipated by Fuller et al. (U.S. Patent No. 4,659,426);

claims 49 and 51 were rejected under 35 U.S.C. §102(e) as being anticipated by Onishi et al. (U.S. Patent No. 5,854,104);

claims 2, 4-7, 20, 22 and 25 were rejected under 35 U.S.C. §103(a) as being unpatentable over Fuller et al.;

claims 12 and 13 were rejected under 35 U.S.C. §103(a) as being unpatentable over Fuller et al. in view of Shih et al. (U.S. Patent Application Publication No. 2002/0066532);

claims 11 and 27 were rejected under 35 U.S.C. §103(a) as being unpatentable over Matsumoto et al. in view of Fuller et al.;

claims 40, 41, 49 and 50 were rejected under 35 U.S.C. §103(a) as being unpatentable over Kosakowski et al.; and

claims 23 and 24 were rejected under 35 U.S.C. §103(a) as being unpatentable over Derwent Acc No 1982-29945D (abstract of JP 56023752) in view of Kosakowski.

These various rejections are traversed and reconsideration of the patentability of the claims is requested in light of the following remarks.

§102(b) Rejection Based on Kosakowski et al.

In the December 3, 2003 Office Action, claims 1, 2, 4-6, 11-14, 21, 22, 25, 27, 30, 31, 35-38 and 51 were rejected under 35 U.S.C. §102(b) as being anticipated by Kosakowski et al. (U.S. Patent No. 5,575,888) (hereinafter Kosakowski). Applicants traverse such rejection.

According to the Office Action, Kosakowski teaches "adding O_2 to the plasma," and the Office Action refers to three different citations in Kosakowski to support such argument (see December 3, 2003 Office Action, page 3, lines 24-25).

Applicants vigorously disagree.

Kosakowski teaches the reduction of undercutting during the etching of refractory metal patterns by exposing the refractory metal to water vapor.

Applicants' claim 1, as amended, recites, *inter alia*:

> **"contacting the noble metal material with an energized plasma composition comprising an etching species mixture for sufficient time to at least partially etch said noble metal material, wherein the etching species mixture comprises (i) at least one halogenated compound selected from the group consisting of organic halogenated compounds, inorganic halogenated compounds and mixtures thereof, *and* (ii) an oxidizing agent selected from the group consisting of oxygen and ozone . . . . ."** (emphasis added)

As such, applicants' claimed invention requires that the oxidizing agent be present with at least one halogenated compound in the etching gas mixture.

By contrast, Kosakowski teaches an etching process wherein the refractory metals are intermittently exposed to O_2 or air to passivate, e.g., mask, the nascent sidewalls of the refractory metal (see Kosakowski, col. 6, lines 24-27). **The intermittent process of Kosakowski requires stoppage of the plasma etch process, evacuation of the plasma and venting of the reaction chamber to the ambient atmosphere, wherein the refractory metal is exposed to oxygen (see Kosakowski, col. 3, lines 3-31).** As such, Kosakowski does not teach that an oxidizing agent such as oxygen is present with at least one halogenated compound during the plasma etching process, as required by applicants' claim 1.

As noted by the Examiner, Kosakowski also teaches the introduction of water vapor, and thus oxygen, "by atmospheric venting . . ." (see, Kosakowski, col. 2, lines 51-52). A thorough scrutiny of Kosakowski verifies that **the introduction of water, and thus oxygen, by atmospheric venting is achieved ONLY during the intermittent passivation process described hereinabove (see, e.g., col. 3, lines 3-18 in combination with col. 5, lines 44-60).** Again, Kosakowski's disclosure fails to teach the presence of oxidizing agent and halogenated compound(s) in the etching gas mixture, as claimed by applicants herein.

Additionally, contrary to the Examiner's contention, Kosakowski does NOT teach adding O_2 to the etching plasma at col. 2, lines 29-42, but rather reflects knowledge common to those skilled in the art in stating that "[t]hese valve metals typically form a protective oxide when exposed to oxygen or water vapor." Clearly, this Kosakowski recital does not teach the presence of oxidizing agent and halogenated compound(s) during the plasma etching process, as required by applicants' claimed invention.

Independent claims 21 and 35 have been amended correspondingly to claim 1.

Kosakowski therefore does not anticipate or provide any derivative basis for the method of applicants' amended claim 1, or the claims dependent thereunder, nor does Kosakowski anticipate or provide any derivative basis for the method of applicants' claims 21, 35 and 51, or the claims dependent thereunder.

Accordingly, applicants respectfully request withdrawal of the §102 rejection of claims 1, 2, 4-6, 11-14, 21, 22, 25, 27, 30, 31, 35-38 and 51 based on Kosakowski.

§102(b) Rejection Based on Matsumoto et al.

In the December 3, 2003 Office Action, claims 1, 4, 5, 21 and 35-37 were rejected under 35 U.S.C. §102(b) as anticipated by Matsumoto et al. (U.S. Patent No. 5,492,855) (hereinafter Matsumoto).

Applicants traverse such rejection.

According to the Office Action, "Matsumoto teaches etching platinum with an RF plasma . . . generated gas mixture comprising a halide . . . and oxygen from SO_2 . . . . (see December 3, 2003 Office Action, at page 4, lines 4-5).

Applicants vigorously disagree.

Matsumoto describes a fine pattern dry etching process for Pt electrodes using RF power sources, wherein the Pt etching speed is increased by the formation of more volatile Pt and S alloys during etching.

Contrary to the contention in the Office Action, O_2 and SO_2 are entirely different chemical species with different chemical and physical properties. It is improper to assert that the presence of oxygen atoms in

the SO_2 molecule qualifies the Matsumoto reference as teaching O_2. SO_2 and O_2 are NOT the same species and are NOT interchangeable or extrapolatable from one to the other.

Further, Matsumoto does not teach oxygen from SO_2. To free one oxygen atom from the SO_2 molecule at the O=SO bond, 553 kJ mol^{-1} of energy is needed,[2] which corresponds to 9.19×10^{-22} kJ of energy.[3] The most energetic radio waves,[4] corresponding to wavelengths of approximately 10 cm, have corresponding energies of 1.99×10^{-27} kJ, which is NOT enough to sever the O=SO bond. As such, Matsumoto does not teach the release of oxygen from SO_2.

Notably, the Examiner contradicts himself in the same Office Action by stating that "Matsumoto does not teach adding O_2 to the plasma gas" (see December 3, 2003 Office Action, page 5, line 25) (emphasis added). Thus, the Examiner's recital emphasizes that applicants' claimed invention is NOT anticipated by the Matsumoto reference.

Additionally, Matsumoto does not teach the plasma-assisted etching of a noble metal material comprising Ir.

The foregoing distinguishing remarks directed to claim 1, and the claims dependent thereunder, are equally applicable to independent claims 21 and 35 and the claims dependent thereunder.

As such, the plasma-assisted dry etching method of claims 1, 4, 5, 21 and 35-37 are not in any way anticipated by Matsumoto. Accordingly, applicants respectfully request withdrawal of the §102 rejection of claims 1, 4, 5, 21 and 35-37 based on Matsumoto.

§102(b) Rejection Based on Fuller et al.

In the December 3, 2003 Office Action, claims 1, 11, 14, 21, 27 and 30 were rejected under 35 U.S.C. §102(b) as being anticipated by Fuller et al. (U.S. Patent No. 4,659,426) (hereinafter Fuller).

Applicants traverse such rejection.

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[2] See, Handbook of Chemistry and Physics, CRC Press, 56th edition, 1975-1976, pg F-227.
[3] The energy corresponds to radiation in the vacuum UV region of the electromagnetic spectrum.
[4] As introduced previously, Matsumoto teaches the use of radio waves to etch the platinum.

According to the Office Action, Fuller teaches etching noble metals with a RF plasma generated from a gas comprising halogen-containing compounds and a carbonyl species, e.g., CO or CO_2, wherein O_2 is added to the plasma gas.

Fuller describes methods of etching thin films of refractory metals, specifically molybdenum disilicide, tantalum silicide, copper, gold, tungsten silicide and titanium silicide, by plasma or reactive ion etching, to form interconnects for VLSI integrated circuits (see Fuller, col. 5, lines 13-55).

Applicants' claim 1 recites, *inter alia*:

> **"A plasma-assisted dry etching method for etching a noble metal material . . . wherein the noble metal material comprises Ir."** (emphasis added)

It is apparent from the foregoing that applicants' claimed method of plasma-assisted dry etching a noble metal material, wherein the noble metal material comprises iridium, is not anticipated by the Fuller reference, which discloses the etching of only Mo, Ta, Cu, Au, W and Ti. This fact is underscored by the Examiner's recital in the Office Action that "Fuller does not explicitly teach etching iridium containing material" (see December 3, 2003 Office Action, page 5, line 4).

Accordingly, applicants respectfully request withdrawal of the §102 rejection of claims 1, 11, 14, 21, 27 and 30 based on Fuller.

§102(e) Rejection Based on Onishi et al.

In the December 3, 2003 Office Action, claims 49 and 51 were rejected under 35 U.S.C. §102(e) as being anticipated by Onishi et al. (U.S. Patent No. 5,854,104; hereinafter Onishi). Applicants traverse such rejection.

According to the Office Action, Onishi teaches a method of plasma etching platinum using SiF_4 and O_2.

Applicants' vigorously disagree.

Onishi describes a process for fabricating a nonvolatile semiconductor memory device including the patterning of titanium nitride, platinum films and ferroelectric films, e.g., PZT, PLZT and

$SrBi_2Ta_{2-x}Nb_xO_9$. Notably, the etching gas mixtures disclosed in Onishi are material-specific, e.g., to TiN, Pt and ferroelectric films.

Applicants' claim 49 as amended herein recites:

> **"[a] method for removing from a microelectronic device structure a noble metal residue including at least one metal selected from the group consisting of platinum, palladium, iridium and rhodium, the method comprising:**
>
> **contacting the microelectronic device structure with a gas-phase reactive composition comprising SiF_4 in a sufficient amount to at least partially remove noble metal residue,**
>
> **wherein the gas-phase composition further comprises an oxidizing gas selected from the group consisting of oxygen and ozone."**
>
> (emphasis added)

Contrary to the Examiner's contention, Onishi does not teach the etching of Pt using a mixture comprising oxygen and SiF_4. For example, Onishi discloses that:

> "the Pt film may be etched with an etching gas containing a chlorine-based bas [sic] and a fluorine-based gas . . . The gases used in the invention can be diluted with an inactive gas for use." (see Onishi, col. 4, lines 28-42) (emphasis added)

However, Onishi is completely silent on the meaning of the term "inactive gas." Further, it is well settled and a matter of common understanding in the art of chemistry that an oxidizing agent is NOT considered an inactive gas.

Notably, Onishi does teach the inclusion of oxygen in the titanium nitride etching gas (see Onishi, col. 4, lines 50-54) and the ferroelectric film etching gas (see Onishi, col. 5, lines 39-44), to improve the etching selectivity of the titanium nitride and ferroelectric films relative to titanium oxide and Al films (see Onishi, col. 6, lines 55-61 and col. 7, lines 24-32). However, to reiterate, Onishi does NOT teach the inclusion of oxygen in the platinum etching gas.

As such, applicants' claim 49, wherein a noble metal residue is removed using a gas-phase composition comprising SiF_4 and an oxidizing agent, is not anticipated by Onishi.

The foregoing distinguishing remarks directed to amended claim 49 are equally applicable to claim 51.

Accordingly, applicants request withdrawal of the §102 rejection of claims 49 and 51 based on Onishi.

§103(a) Rejection Based on Fuller

In the December 3, 2003 Office Action, claims 2, 4-7, 20, 22 and 25 were rejected under 35 U.S.C. §103(a) as being unpatentable over Fuller. Applicants traverse such rejection.

According to the Office Action:

> "it would have been obvious to one skilled in the art to apply the method of Fuller to the etching of iridium containing material because Fuller teaches that the method is generally applicable to refractory metals and Ir is one of a small group of elements known as refractory metals."

Applicants vigorously disagree.

Considering Fuller as a whole, as the Examiner must do,[5] Fuller does not teach or suggest every limitation of applicants' claimed invention, including plasma-assisted dry etching a Group VIIIB metal such as iridium.

For example, referring to the portion of the Periodic Table recreated below and representative of the transition metal region, Fuller completely lack any disclosure or suggestion of etching of Group VIIIB metals, including iridium. For ease of reference, the etching of the transition elements shaded in grey are disclosed in Fuller.

IIIB	IVB	VB	VIB	VIIB	← VIIIB →			IB	IIB
Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn
Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd
La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg

[5] *See, W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 220 U.S.P.Q. 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984).

Notably, the Group IB-VIIB metal compounds have fundamentally different chemical and physical properties from the Group VIIIB metal compounds. For example, the Group VIIIB elements in the fifth and sixth periods, e.g., Ru, Rh, Pd, Os, Ir and Pt, are commonly referred to as the "noble metals"[6] because of their renowned inertness. Given this inertness, the physical and chemical conditions necessary to etch noble metal-containing films will vary substantially from those conditions necessary to etch other, more reactive, transition metal-containing films.

As such, one skilled in the art of plasma-assisted dry etching would not in any logical manner look to the Fuller teaching of Group IB-VIIB metal compound etching for guidance in etching Group VIIIB iridium-containing films. Specifically, the process conditions required for the etching of Group IB-VIIB metal compounds does NOT embody, imply or extrapolate to the process conditions required for the etching of Group VIIIB metal iridium-containing films.

As such, Fuller is devoid of any disclosure of etching of Group VIIIB metal compounds, including iridium-containing films.

Additionally, the Office Action states that "Fuller teaches adding O_2 to the plasma gas" (see December 3, 2003 Office Action, page 4, lines 10-11). Fuller teaches adding O_2 to the plasma gas to control the substrate temperature and photoresist erosion (see Fuller, col. 4, lines34-37). Clearly, photoresist[7] and noble metal materials are NOT similar substances and as such, the Fuller teaching that oxygen controls photoresist erosion does not motivate or suggest to one skilled in the art that oxidizing agents could be added to an etching composition to usefully etch noble metal materials.

Since there is no motivation, teaching or suggestion to modify Fuller and since the recited features of applicants' claimed invention are not in any way disclosed or suggested in the Fuller reference, applicants request withdrawal of the rejection of claims 2, 4-7, 20, 22 and 25 under 35 U.S.C. §103(a) over Fuller.

§103(a) Rejection Based on Fuller in view of Shih et al.

In the December 3, 2003 Office Action, claims 12 and 13 were rejected under 35 U.S.C. §103(a) as being unpatentable over Fuller in view of Shih et al. (U.S. Patent Application No. 2002/0066532) (hereinafter Shih).

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[6] also commonly referred to as the platinum group metals.
[7] Photoresist is an organic polymer which becomes soluble when exposed to ultraviolet light. *See*, http://www.intl-light.com/photoresist.html.

Applicants traverse such rejection.

There is no motivation or suggestion in either Fuller or Shih to combine the two references.

Considering Fuller as a whole, as the Examiner must do,[8] Fuller **requires** the inclusion of carbon monoxide or carbon dioxide in the etching plasma to etch a metal or metal composite by volatilization of the metal in the thin film as a carbonyl or carbonyl halide (see Fuller, col. 2, lines 48-55).[9] Fuller, in discussing a representative embodiment of his disclosure, reports that:

> "[t]he etch was found to be selective to silicon dioxide. The anisotropy of the etch was good: the etch lines appeared to have a sidewall slope greater than four to one." (see Fuller, col. 5, lines 13-30)

Given that Fuller states that the etching results were "good," where is the incentive to change the Fuller etching composition? Moreover, where is the motivational basis or suggestion in Fuller for the proposition that an etching gas composition devoid of CO or CO_2, e.g., containing only halogen-based species and oxygen, will efficaciously etch a noble metal material? Clearly, there is none and as such, there is no tenable basis for the Examiner's proposed modification.

Applicants respectfully submit that the Examiner cannot selectively focus on isolated individual elements of the primary reference, while simultaneously overlooking other elements taught to be necessary. Such an approach is merely a reconstruction of applicants' invention based on hindsight, which is not a proper basis for establishing obviousness. *In re Gorman*, 18 U.S.P.Q.2d 1885, 1888 (Fed. Cir. 1991).

Shih does not cure the deficiencies of Fuller. Shih generally relates to a corrosion-resistant protective coating for a chamber containing plasma or processing gas. Shih does not provide any insight into effective etching compositions.

The Examiner is respectfully reminded that the mere fact that references can be combined does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *In re Mills*, 16 U.S.P.Q.2d 1430 (Fed. Cir. 1990).

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[8] *W.L. Gore & Associates, Inc. v. Garlock, Inc.*, 220 U.S.P.Q. 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984).

[9] In fact, an embodiment disclosed in Fuller (to etch molybdenum disilicide) utilizes an etch gas mixture comprising 15 standard cm^3 min^{-1} (SCCM) CO_2 and 2 SCCM of O_2. This corresponds to a CO_2:O_2 mole ratio of approximately 7.5:1.

As such, the combination of Fuller and Shih (though there is nothing in either of such references that would motivate such combination) fails to motivate or suggest applicants' claimed invention, wherein an oxidizing agent such as oxygen is present in the etching gas mixture to "assist in the volatilization and removal of iridium product species from the iridium-based material on the substrate."

Applicants therefore request withdrawal of the rejection of claims 12 and 13 under 35 U.S.C. §103(a) based on Fuller in view of Shih.

§103(a) Rejection Based on Matsumoto in view of Fuller

In the December 3, 2003 Office Action, claims 11 and 27 were rejected under 35 U.S.C. §103(a) as unpatentable over Matsumoto in view of Fuller. Applicants traverse such rejection.

According to the Examiner:

> "[i]t would have been obvious to one skilled in the art to add O_2 to the method of Matsumoto because Fuller teaches that by adding O_2 one obtains control over substrate temperature and photoresist erosion and Matsumoto's use of SO_2 demonstrates that no ill effects would be expected upon adding the O_2 as taught by Fuller."

Applicants vigorously disagree.

As introduced hereinabove, neither Matsumoto nor Fuller teaches or suggests applicants' claimed invention, wherein the noble metal material to be etched comprises iridium. As such, all of the recited features of applicants' claimed invention are not in any way disclosed or suggested in Matsumoto, Fuller or a combination thereof.

Further, there is no motivation or suggestion in Matsumoto or Fuller to combine the two references. Respectfully, the Examiner has failed to explain with specificity what areas of the references suggest the combination, as required to make a legally sufficient rejection based on a combination of references. *Ex parte Humphreys*, 24 U.S.P.Q.2d 1255, 1262 (B.P.A.I. 1992).

Considering Matsumoto as a whole, the thrust of the Matsumoto reference is that the etching gas MUST contain a sulfur component, e.g., from SO_2, so that the sulfur atoms can be incorporated within the Pt

metal lattice to increase the rate of etching.[10] Matsumoto does NOT teach that the oxygen atoms of the SO_2 molecule are a necessary constituent of the etching composition. Additionally, as discussed hereinabove, the conditions of Matsumoto could not possibly result in the generation of oxygen atoms from the SO_2 molecule.

Fuller requires the inclusion of CO or CO_2 in the etching gas composition.

Again, the Examiner appears to be selectively focusing on isolated individual elements of the primary and secondary references, while simultaneously overlooking other elements taught to be necessary. If one were to combine the Matsumoto and Fuller teachings (though there is nothing in such references that would motivate such combination), where is the motivation or suggestion to remove the CO/CO_2, e.g., from Fuller, and the sulfur component, e.g., from Matsumoto, to produce an etching gas composition devoid of both? Clearly, there is no credible basis for the Examiner's hypothetical combination.

Moreover, Matsumoto teaches the etching of Pt, which is a Group VIIIB element. As discussed hereinabove, one skilled in the art of plasma-assisted dry etching would not in any logical manner look to the Fuller teaching of Group IB-VIIB metal compound etching for guidance in etching Group VIIIB platinum-containing films. Accordingly, one skilled in the art would not logically combine the teachings of Matsumoto and Fuller.

In sum, there is no motivation, suggestion or basis in Fuller or Matsumoto to combine the two references, and the recited features of applicants' claimed invention are not in any way disclosed or suggested in the two references. Applicants therefore request withdrawal of the §103(a) rejection of claims 11 and 27 over Matsumoto in view of Fuller.

§103(a) Rejection Based on Kosakowski

In the December 3, 2003 Office Action, claims 40, 41, 49 and 50 were rejected under 35 U.S.C. §103(a) as unpatentable over Kosakowski. Applicants traverse such rejection.

Notably, the Examiner stated that "[t]he above noted teachings of Matsumoto are herein relied upon" (see December 3, 2003 Office Action, page 6, line 5), even though the paragraph heading and the remainder of the rejection failed to refer in any way to the Matsumoto reference. As such, applicants are responding to

[10] According to Matsumoto, the boiling point of Pt is as high as 3804°C. By mixing a very small quantity of S into

the §103(a) rejection based on Kosakowski alone, since that reference is the sole reference discussed in the statement of rejection in the Office Action.

According to the Examiner:

> "[i]t would have been obvious to one skilled in the art to use SiF_4 because Kosakowski teaches using SiF_6 which the skilled artisan would recognize as being an equivalent of SiF_4 in terms of plasma reactive sopecies [sic] thath [sic] would gbe [sic] generateds [sic] upon plasma excitation."

Applicants disagree.

As discussed hereinabove, Kosakowski fails to teach or suggest every limitation of applicants' claimed invention, including the presence of the oxidizing agent with at least one halogenated compound in the etching gas mixture.

Moreover, considering Kosakowski as a whole, Kosakowski does not motivate or suggest one skilled in the art to go in the direction of applicants' claimed invention, wherein oxidizing agents are present in the etching gas mixture. As discussed hereinabove, Kosakowski relates to the reduction of undercutting during the etching of refractory metal patterns, which is accomplished by exposing the refractory metal to water vapor during plasma etching. The introduction of water vapor into the etching chamber passivates, e.g., halts the etching of, the nascent sidewalls of the refractory metal that form during plasma etching.

Why would one skilled in the art reading the Kosakowski reference, which teaches passivation of sidewall etching subsequent to controlled patterning, go in the direction of applicants' claimed invention, wherein oxidizing agents are added to the etching species mixture to enhance the etching process (see instant specification, page 10, paragraph [0032])? Clearly, they would not and there is no credible basis for the Examiner's proposed modification.

Since there is no motivation, suggestion or teaching to modify Kosakowski, and since the recited features of applicants' claimed invention are not in any way disclosed or suggested in the Kosakowski reference, applicants respectfully request withdrawal of the rejection of claims 40, 41, 49 and 50 under 35 U.S.C. §103(a) over Kosakowski.

Pt, evaporation starts at about 1175°C (see Fuller, col. 6, lines 8-13).

§103(a) Rejection Based on Derwent Acc No 1982-29945D in view of Kosakowski

In the December 3, 2003 Office Action, claims 23 and 24 were rejected under 35 U.S.C. §103(a) as being unpatentable over Derwent Acc No 1982-29945D[11] (hereinafter Derwent `45D) in view of Kosakowski. Applicants traverse such rejection.

As discussed hereinabove, claim 23 has been amended to correct a typographical error. Claim 23 now recites:

> **"23. The method according to claim 21, wherein the etch species comprise C_2F_6 in the presence of O_2."**

Claim 3 has been correspondingly amended.

Considering the amendment of claim 23, claims 23 and 24 are now in form and condition for allowance. Nonetheless, a response to the Examiner's rejection is submitted hereinbelow.

According to the Examiner:

> "Derwent `45D does not teach adding $O_2$ to the etchant. Kosakowski teaches adding $O_2$ to the etchant. It would have bween [sic] obvious to one skilled in the art to add $O_2$ to the Derwent `45D method because Kosakowski teaches that this allows one to control the etching profile." (emphasis added)

Applicants vigorously disagree.

Derwent `45D relates to dry etching an electrically conductive film, such as Pt, using a halogen gas containing material comprising halogen radical-absorbing groups, wherein the halogen radical-absorbing groups include $C_2H_4$, $H_2$ and $C_2H_6$. The only etching gas embodiment disclosed in the Derwent `45D reference consists of CCl_4, C_2H_4 and He.

By the Examiner's own admission, Derwent `45D does not teach or suggest all of the limitations of applicants' claimed invention, e.g., adding $O_2$ to the etchant. Moreover, Derwent `45D does not teach or suggest an etch species comprising C_2F_6 in the presence of O_2.

[11] Derwent Acc No 1982-29945D relates to Japanese Publication No. 56-023752, in the name of Matsushita Electronics.

Kosakowski does not cure the deficiencies of Derwent `45D. Contrary to the Examiner's contention, Kosakowski does not teach the presence of an oxidizing agent such as oxygen with at least one halogenated compound in the etching gas mixture. As described hereinabove, Kosakowski discloses the "intermittent exposure to O_2" of the refractory metals to be etched (see Kosakowski, at column 6, lines 24-27).

As such, the combination of Derwent `45D and Kosakowski (though notably, there is nothing in such references that would motivate their combination) fails to teach every limitation of applicants' claimed invention.

Applicants therefore respectfully request withdrawal of the §103(a) rejection of claims 23 and 24 based on Derwent `45D in view of Kosakowski.

Fees Payable for Terminal Disclaimer

The Terminal Disclaimer fee of $110.00 is authorized to be charged in the attached credit card authorization form. Authorization is also hereby given to charge any deficiency for this response, in applicable fees or charges, to Deposit Account Number 08-3284 of Intellectual Property/Technology Law.

CONCLUSION

Based on the amendments made herein and the foregoing remarks, claims 1, 3-5, 7-21 and 23-51 are now in form and condition for allowance. The Examiner therefore is respectfully requested to reconsider and allow such claims.

Respectfully submitted,

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